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ST. DAVID'S ROCKS AND UNIVERSAL LAW.

A DISCUSSION of the St. David's rocks has been opened in the Geological society of London by Prof. A. Geikie, director of the Geological survey of Great Britain and Ireland, which possesses great interest to all persons engaged in the study of the older crystalline rocks. The St. David's rocks, according to Dr. Hicks, consist of three distinct pre-Cambrian formations in ascending order: the Dimetian, composed of crystalline, gneissic, and granitoid rocks; the supposed unconformable Arvonian, formed of felsites, quartz porphyries, hälleflintas, etc.; and the Pebidian, supposed to be unconformable to both the preceding, and made up of tufas, volcanic breccias, and basic lavas. The Cambrian is said to overlie all these, and to have a basement conglomerate composed of their ruins.

Dr. Geikie maintains that the Dimetian is an eruptive granite, which has disrupted and altered the Cambrian strata, even above the horizon of the supposed basal conglomerate. Besides a pebbly quartzite formed of fragments torn from the Cambrian conglomerate and greatly indurated, no rock, except diabase, is found, according to him, in the granite area; and this occurs throughout the entire district. The granite cuts through successive horizons of the Cambrian strata, and is younger than all of that formation in the district. The Arvonian consists of quartziferous porphyries, or elvans (associated with the granite), and of the metamorphosed strata adjacent. The Pebidian consists of a series of volcanic tufas and breccias, with interstratified and intrusive lavas.

Geikie holds that the Pebidian is an integral part of the Cambrian. It is cut by the Arvonian porphyry and Dimetian granite, and is therefore older than these. It is covered quite conformably by the Cambrian conglomerate, and not unconformably, as Hicks claimed. Seams of tufa are interstratified at various horizons in the conglomerate and strata above. This Cambrian conglomerate, instead of being composed of fragments of the Dimetian, Arvonian, and Pebidian, consists almost entirely of quartz and quartzite; "only four per cent of fragments having been found to have been derived from some of the projecting lava-islands underneath it." Professor Geikie then claims that the names Dimetian, Arvonian, and Pebidian "had been founded on an error of observation, and they ought to be dropped out of geological literature."

Prof. A. Renard also states that he had examined these rocks microscopically, in concert with Drs. Zirkel of Leipzig, and Wichmann of Utrecht; and their conclusions are, that the so-called Dimetian rock is unquestionably a true granite (eruptive). The quartz porphyries were like the contact specimens of granite, and believed to be such. The tufa found in and above the conglomerate is a true tufa, and not a mere superficial waste of older volcanic rocks. The observed foliation existed above the conglomerate as well as below.

That the questions involved in Dr. Geikie's position are deeply interesting, is manifest from the fact that some fourteen persons joined in the discussions which followed its statement. These questions are of equal interest to American geologists and petrographers, since they are the same as those the present writer has raised regarding eastern Massachusetts, — a district similar to St. David's, — also similar to those raised by Professor Dana against the Taconian, Montalban, and Huronian, in New England; by Dr. Selwyn, concerning the Norian, Montalban, and Taconian, in Canada; by Messrs. Whitney, Selwyn, Winchell, and Wadsworth, with respect to the Lake Superior geology; and by Geikie and Wadsworth, regarding the Fortieth parallel exploration.

The writer has nowhere seen any general statement of the bearings of these questions; and it may be briefly indicated here what some of them seem to him to be. They seem to be involved in the distinction between one universal law, moving in a uniform, definite direction, and recurrent phenomena or special creations and conditions. Under the latter view there seems to belong the belief that detrital or chemical sediments are returned to eruptive forms; that eruptive rocks are of chemical or sedimentary origin; that these were different in pre-tertiary time from what they were in the tertiary; that certain geological periods are marked by certain kinds of rock; that the azoic system has been subdivided upon natural principles; that there have been recurrent periods of heat and cold. This view includes the theory of the metamorphic origin of granite, the present geologico-mineralogical classification of rocks, and embraces uniformitarianism, catastrophism, plutonism, and neptunism.

The other maintains the existence of a universal law, which should be the guide in all investigations, — a law, which, in its more special applications, Professor Whitney has endeavored to illustrate in his Climatic changes, and Sir William Thomson in his papers on the age of the earth and sun, — a law which the present writer has tried to express in his petrographical work. It is regarded as the law which will one day be completely worked out, and in accordance with which our views in history, philosophy, science, — all branches of human knowledge, — will then be reconstructed. The expression of the law varies in different ages, but for the physical universe it seems best formulated at the present time by Sir William Thomson: The degradation and dissipation of energy, the passage from the unstable towards a more stable condition, the tendency to harmonize with the environment, — the law under which the universe has moved from the beginning, and under which it will continue its course uniformly towards the end; it assumes that no turning-back can occur, and that no energy once lost can be restored, except by the same Almighty Power which gave it birth.

M. E. WADSWORTH.

THE HUMAN REMAINS OF THE BONE-CAVERNS OF BRAZIL.

THE discovery by the late Dr. Lund of human remains associated with the extinct mammalian fauna of the caverns of Lagoa Santa in the province of Minas Geraes, Brazil, made famous by his researches, has, until recently, passed almost unnoticed among ethnologists. Dr. Lund's statements in the communications which accompanied the human bones, sent to the societies of Rio de Janeiro and Copenhagen, are, I believe (I write without the documents for reference), unqualified as to the direct association of the human with the extinct mammalian remains, and have been received as conclusive by prominent ethnologists. There can be no question of Dr. Lund's perfect good faith in the matter; but it may be asked whether, forty years ago, such care as is now considered necessary in such investigations would have been exercised, even by so able and conscientious an observer as Lund is recognized to have been.

So long a time has elapsed, that it is now difficult to verify the exact conditions under which the bones

were found. In a recent flying trip through the Lagoa Santa region, I made inquiries in regard to the matter, but failed to obtain any very definite information. According to the reports of the common people, many caverns were explored by Lund and his assistants in person for the express purpose of collecting fossils, while others were worked by the people of the vicinity for saltpetre, who, under instructions from Lund, and probably as far as possible under his supervision, saved the fossils disinterred in their operations. I could learn nothing as to the conditions under which the human skull now in the museum at Rio de Janeiro, and stated to have been found with remains of extinct mammals, was met with. More definite, and apparently reliable information was given in regard to a complete human skeleton which was one of a lot sent to Copenhagen. A workman in one of the saltpetre caves at some distance from Lagoa Santa found the skeleton in his work, and, to gain the reward offered, took it to Lund, who gave him the sum of forty milreis (about twenty dollars). This man is still alive; but, from lack of time, I was unable to see him. It is said, that, on his recent visit to Minas, the emperor had an interview with him on the subject.

Recently, while in New York, I had the good fortune to meet Mr. Nicholas Brandt, son of the late Prof. P. A. Brandt, who was for many years the secretary and companion of Dr. Lund. Mr. Brandt, who had spent some time at Lagoa Santa in company with his father and Dr. Lund, kindly gave me the following note: "The remains of the prehistoric man, discovered by Dr. Lund in Minas before I came to Brazil, and about which the professor sent his memoirs to the *Instituto historico e geographico* of Rio de Janeiro in January, 1842, and April, 1844, were often the subjects of our conversation. The doctor's opinion was positive that the skeletons belonged to the same period as the fossil fauna with which he enriched the knowledge of natural history to such a large extent. The opinion of Cuvier and Humboldt, Dr. Lund's friends, was fully justified in urging the doctor to go to Brazil, and use his energies in the service of this branch of science. The doctor was, of course, a pure follower of his friend Cuvier. Darwin and Darwinism were at that time hardly heard of, as his *Blik paa Braseliens Dyreverden* fully shows." Mr. Brandt adds, that but for the loss of all his private papers, including his Brazilian journal, and many letters from his father and Dr. Lund, in the Atlantic disaster some years ago, he would have been able to give a much more definite and detailed account of Lund's life and work at Lagoa Santa.

ORVILLE A. DERBY.

LETTERS TO THE EDITOR.

Solar constant.

THIS term is becoming prominent, and its use has given rise to some confusion. I find some authorities, taking the value given by Forbes, give 28.2 calories, while others give 2.82 calories. Since a calorie is the definite amount of heat required to raise a kilogram of water 1° C., it is evident that one of these is in error.

Professor Young, in his 'Sun,' p. 263, defines the solar constant as the amount of heat received per minute by one square metre exposed perpendicularly to the sun's rays at the upper surface of the atmosphere. No mention is made of the substance receiving the heat. In correspondence with Professor Young, I have received the following equation: the solar constant $= \frac{w}{s} \times \frac{t}{m}$, in which w = mass of water, s = surface, t = quantity of heat, m = unit of time. On this basis we may define the solar constant as the amount of heat received in a unit of time, by a unit of mass, spread upon a unit of surface, exposed as above. In this equation, however, we may divide w by s, and obtain d = depth, and we shall have the solar constant $= \frac{d \times t}{m}$; i.e., the solar constant equals the quantity of heat received from the sun at the limit of the earth's atmosphere, by a unit of depth of water, in a unit of time.

We may express this numerically as follows: take a square metre and spread upon it a kilogram of water; it will lie 1 mm. deep. Since the kilogram is the unit used in defining the calorie, we may say, using Forbes's value, that the solar constant, 28.2 calories, is the amount of heat received by 1 mm. depth of water exposed as above. The use of the term 'calorie' seems unfortunate; and we might adopt, as more satisfactory, a centimetre as the unit of depth, and degrees as expressing heat. We would then have the solar constant equal to 2.82 Centigrade-centimetre-minute degrees, or 2.82 ccm°.; i.e., the sun's heat falling upon a centimetre depth of water would raise it 2.82° C. in one minute.

This will be recognized as of the same form of expression as adopted by Herschel, who describes the sun's heat as sufficient to melt a coating of ice an inch thick in 2 h. 13 m. nearly. H. A. HAZEN.

Spanish folk-lore.

In the account of folk-lore in Europe, in SCIENCE for May 25, I see no notice of Spanish efforts in that field. My acquaintance with the subject is but slight, yet it has extended to the important and interesting works of Antonio de Trueba, who, in 1873, spoke of himself as "almost the only writer of our country who has given himself with any diligence to this task (the collection of popular stories), especially now that the illustrious Fernan Caballero rests from his most glorious labors." The method of Trueba differs from that of the brothers Grimm, for example, in that he adds the polish of his admirable style to the rough form of the stories as they fall from the mouth of the people; such a process being necessary, he maintains, in order to fit them for a place among the products of the literary art. I subjoin a list of his publications in this department: *Cuentos de color de rosa, Cuentos campesinos, Cuentos populares, Cuentos de vivos y muertos, Cuentos de varios colores,* and *Narraciones populares.* ROLLO OGDEN.

Cleveland, O., May 28.

Capture of the crested seal on the coast of Massachusetts.

At various times large seals have been seen or taken on the coast of Massachusetts, and, although in no case positively identified, presumed to be examples of the crested seal (Cystophora cristata), mainly because a specimen of this species, described long since by Dr. DeKay, was taken in 1824 in a small creek emptying into Long Island Sound at East Chester, about fifteen miles from New-York City. As two other large seals — the gray seal (Halichoerus grypus) and the bearded seal (Erignathus barbatus) — are almost as likely to occur on the New-England coast as this one, it is some satisfaction to be able to record the capture of a well-identified example of the crested seal in Newburyport harbor, May 2, 1882. Mr. E. C. Greenwood of Ipswich, by whom the specimen was secured and mounted, informs me that